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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/627,559	07/27/2000	Jorg Schultz	637.0003USU	3757

7590 06/27/2002

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EXAMINER

SOUW, BERNARD E

ART UNIT

PAPER NUMBER

2881

DATE MAILED: 06/27/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/627,559

Applicant(s)

SCHULTZ ET AL.

Examiner

Bernard E Souw

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 July 2000.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 38-59 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 38-59 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 July 2000 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4,7.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Drawings

2. The drawings are objected to because Fig.3 and Fig.7 contain manually corrected labels. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

3. The disclosure is objected to because of the following informalities:

- Pg.3, line 26, "*the aperture in the plane of the wafer is $NA_{wafer} = 0.1-0.25$* " is inconsistent with the generally accepted meaning of the terminology used:

- (a) An *aperture* must have a dimension of $[L^2]$, however NA_{wafer} is here given as dimensionless.

- (b) In optics, a dimensionless NA is conventionally used to denote Numerical Aperture (see, e.g., USPAT 6,268,984 B1, Col.1/ll.26-32). However, Numerical Aperture is conventionally referred to a (projection) lens, as generally understood in the art (see, e.g., USPAT 6,268,984 B1, Col.1/ll.31-32), but not to a "*plane (of a wafer)*", as here used by the Applicant.

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- Pg.3, line 27, the same unconventional and inconsistent use of aperture vs NA (numerical aperture) as already objected in the previous line 26.
- Pg.4, line 4, " 0.149 mm_2 " should correctly be written as " 0.149 mm^2 ".
- Pg.4, line 13, "*The Etendu of a laser plasma source **can be roughly calculated as***", should correctly read "*The Etendu of a laser plasma source **is defined as***".
- Pg.4, line 16, "square of the **aperture angle** " should read "square of the **Numerical Aperture**".
- Pg.4, line 19, " $A^{\text{LPQ}} = 2\pi [\cos(\theta_1) - \cos(\theta_2)]$ has an incorrect unit, since A^{LPQ} is defined as an area. Correct would be " $A^{\text{LPQ}} = 2\pi [\cos(\theta_1) - \cos(\theta_2)] \times (R_{\text{sphere}})^2$, with $R_{\text{sphere}} = 1\text{mm}$."
- Pg.4, line 20, the formulation " $\text{NA} \approx r_{\text{source}}/1\text{mm}$ " should read -- by definition of the Numerical Aperture -- " $\text{NA} \approx r^{\text{LPQ}}/R_{\text{sphere}}$ ", where r^{LPQ} is consistently the radius of the plasma source (Note: end formula in line 25 is left unchanged).
- Pg.5, line 12, " $\pi \cdot 1 \text{ mm}^2 / 4 \cdot 0.3053^2$ " should be better written as " $(\pi \cdot 1 \text{ mm}^2 / 4) \cdot 0.3053^2$ ".
- On Pg.10, the term "**now US patent No. 6,198,793 B1**" should be inserted in line 3 after "*.. EUV-lithography*", prior to "*PCT/EP ...*".

Appropriate corrections are required.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

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A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

Claims 38 and 40-42 are rejected under 35 U.S.C. 102(a) and (e) as being anticipated by Yamamoto, Chikara (USPAT 6,325,514 B1), hereafter denoted as Yamamoto (Ch), to distinguish from another Yamamoto's cited in PTO-892 here attached.

Yamamoto (Ch) discloses an illumination system 10 shown in Fig.2 and recited in Col.4/ll.12-20, comprising:

- a plurality of primary light sources 10, as shown in Fig.2 and recited in Col.4/ll.24-25;
- an optical unit 11 combining the plurality of primary light sources 10 into a plurality of secondary light sources, as recited by Yamamoto (Ch) in Col.4/ll.29-37.
- a first plurality of raster elements 11, consisting of 11A, 11B and 11C, as recited in Col.4/ll.31-37, or equivalently raster elements 111 in Fig.5, consisting of 111A, 111B, 111C and 111D, as recited in Col.6/ll.43-67, transforming the plurality of primary light sources 10 into a plurality of secondary light sources 70A & 70B shown in Fig.3A & 3B, respectively, as recited in Col.5/ll.43-53;
- wherein the first plurality of raster elements 11A is imaged into a plane 23B (also 23G and 23R) as shown in Fig.2, whereby a plurality of images is formed, as recited in Col.4/ll.42-47.

The limitation "for wavelengths ≤ 193 nm" is not given any patentable weight, because it is recited in the preamble of the claim. However, the limitation would have been obvious over Schultz et al. in Col.1/ll.9-15 (see rejection of claims 53 & 56).

5. Regarding claim 40, the limitation of a collector unit is disclosed by Yamamoto (Ch) as integrator 111, detailed in Fig.5 and recited in Col.6/ll.43-46.

6. Regarding claim 41, each of Yamamoto (Ch)'s raster elements 11C in Fig.1 & 2 and 11C/D in Fig.5, has a planar surface, as recited in Col.6/ll.46-50.

7. Regarding claim 42, each of Yamamoto (Ch)'s first plurality of raster elements 11C is arranged and oriented to superimpose the plurality of images in the (reticle) plane (of claim 38) forming an illuminated field at the plane(s) 23B or 23G or 23R shown in Fig.2, as recited in Col.4/ll.42-47.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 43 and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto (Ch) in view of Yamamoto et al. (JP 411044920 A).

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Yamamoto (Ch) recite all the limitations of claims 43 and 44, as applied to claims 38 and 40-42 above, except the limitation that the optical unit of claim 38 has a shape of a pyramid with a plurality of sides, and that each of the plurality of sides is oriented to superimpose the plurality of images in the (reticle) plane (of claim 38).

- Regarding claim 43, Yamamoto et al. disclose an illumination system very similar to Yamamoto (Ch)'s. Yamamoto et al.'s optical unit 11 shown in Fig.1 has a shape of a pyramid 11C with a plurality of sides, each of which corresponds to each of the primary light sources, as is obvious in Fig.1 and recited in the SOLUTION section of the Abstract, lines 1-9.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Yamamoto (Ch)'s optical unit 11 (or integrator) with Yamamoto et al.'s integrator 11 of Fig.1, since their image-combining effects are both the same.

One would have been motivated to modify Yamamoto (Ch)'s Fresnel-shaped optical unit 11 with Yamamoto et al.'s pyramid-shaped optical unit 11, since the latter is easier to fabricate.

- Regarding claim 44, each of Yamamoto et al.'s plurality of pyramid sides 11C is oriented to superimpose the images on the (reticle) plane (of claim 38), as recited in the SOLUTION section of Yamamoto et al.'s Abstract, lines 4-9.

10. Claims 39 and 45-47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto (Ch) in view of Ohzawa et al. (USPAT 5,993,010).

Yamamoto (Ch) recite all the limitations of claims 39 and 45-47, as applied to claim 38 above, except for additional limitations that will be individually addressed for each claim in the following.

- Regarding claim 39, Ohzawa et al. describe an illumination system very similar to Yamamoto (Ch)'s, showing a first plurality of raster elements 10 in Fig.1, as recited in Col.2/ll.64-68, 16 in Fig. 8, as recited in Col.6/ll.59-63, and 28 in Fig.13, as recited in Col.11/ll.21-23. Each of Ohzawa's first plurality of raster elements is obviously concave, as shown by label 100 in Fig.1, recited in Col.3/ll.26-27 and label 160 in Fig.8, recited in Col.7/ll.9-11.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to make Yamamoto (Ch)'s first plurality of raster elements 10 in Fig.1 concave, as taught by Ohzawa's, in order to form secondary light sources on the plane of second plurality of raster elements 20, so the image formed by the second plurality of raster elements 20 on the (reticle) plane 4 is uniform.

One would have been motivated to uniformly illuminate the reticle plane 4, where a mask may be placed, so the latter may be uniformly projected on the light-sensitive object, in order to have an accurate duplicate of the mask pattern on the light-sensitive object after an etching process.

- Regarding claim 45, Ohzawa's illumination system shows a second plurality of raster elements 20 in Fig.1, recited in Col.2/ll.64-68, raster elements 26 in Fig.8 as recited in Col.6/ll.59-63, raster elements 27 in Fig.9, as recited in Col.8/ll.34-35, and raster elements 28 in Fig.13, as recited in Col.11/ll.21-23.

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- Regarding claim 46, Ohzawa's illumination system shows a first plurality of raster elements 190 and a second plurality of raster elements 290 in Fig.14 (Prior Art), recited in Col.1/II.24-29, wherein the second plurality of raster elements 290 is located at the plurality of secondary light sources 194, wherein each of the plurality of secondary light sources 194 is located on one of the second plurality of raster elements 290, as recited in Col.1/II.24-29, and wherein each of the second plurality of raster elements 290 and each of the plurality of secondary light sources 194 is arranged and oriented to superimpose the plurality of images in the (reticle) plane (of claim 38) forming an illuminated field, as shown in Fig.14 and recited in Col.1/II.31-36.
- Regarding claim 47, Ohzawa's each of the second plurality of raster elements 26 in Fig.8 and 28 in Fig.13 is concave, as recited in Col.6/II.59-63 & Col.7/II.39-41, and Col.11/II.22-23, respectively.

11. Claims 48-52 and 54-55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto (Ch) in view of Ohzawa et al., as applied to claims 46 and 47 above, and further in view of Yamamoto et al., as already applied to claims 43 and 44 above.

Yamamoto (Ch) as modified by Ohzawa et al. recite all the limitations of claims 48-52 and 54-55, as applied to claims 46 and 47 above, except for additional limitations that will be individually addressed for each respective claim in the following:

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- The limitations of claims 48 and 50 are the same as those of claim 47 and claim 43 combined. Claims 48 and 50 are thus rejected over a combination of the respective prior arts.
- The limitations of claims 49 and 51 are the same as those of claim 48 and claim 44 combined. Claims 49 and 51 are thus rejected over a combination of the respective prior arts.
- Regarding claims 52, 54 and 55, the limitations that the optical unit comprises a second plurality of raster elements and that each of each of the second plurality of raster elements 290 and each of the plurality of secondary light sources 194 is arranged and oriented to superimpose the plurality of images in the (reticle) plane (of claim 38) forming an illuminated field, are already addressed in the rejections of claims 46, 50 and 51 above. Claims 52, 54 and 55 are thus rejected over a combination of the respective prior arts.

12. Claims 53 and 56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto (Ch) in view of Ohzawa et al. and Yamamoto et al., and further in view of Schultz et al. (USPAT 6,198,793 B1).

Yamamoto (Ch) in view of Ohzawa et al. and Yamamoto et al. recite all the limitations of claims 53 and 56, as previously applied to claims 51 and 54 above, except the recitation that each of the second plurality of raster elements has a planar surface.

Schultz et al. disclose an illumination system (for wavelengths ≤ 193 nm) very similar to Yamamoto (Ch)'s, Ohzawa et al.'s and Yamamoto et al.'s. Schultz's second

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plurality of raster elements 9 and 14 shown in Fig.1 and Fig.3, respectively, has a planar surface, as recited in Col.7/ll.49-53 and Col.8/ll.22-25, respectively.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use planar mirrors as taught by Schultz for the second plurality of raster elements, in order to simultaneously mix and focus the secondary light sources onto the (reticle) plane, or exit pupil, so a uniformly illuminated field can be formed where a photolithographic mask may be placed.

One would have been motivated have a uniformly illuminated photolithographic mask, in order to produce an accurate pattern of the mask on the semiconductor chip.

13. Claims 57-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto (Ch) in view of Tanitsu (USPAT 6,236,449 B1).

Yamamoto (Ch) recites all the limitations of claims 57-59, as previously applied to claim 38 above, except for additional limitations to be addressed individually as follows:

- Regarding claim 57, Tanitsu's illumination system comprise an optical element 40a and an exit pupil P2, as shown in Fig.1A and Fig.1B, wherein the optical element is situated between the plurality of secondary light sources formed at F and the (reticle) plane (of claim 38) at P2, to image the plurality of secondary light sources into the exit pupil, as recited in Col.3/ll.54-55..
- Regarding claim 58, Tanitsu's illumination system comprises:
 - a mask 48 located in the (reticle) plane, as recited in Col.3/ll.56-57;

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- a projection objective lens 54, as recited in Col.3/ll.56-57; and
- a light-sensitive object 60, wherein an image of the mask 48 is formed on the light sensitive object 60, as recited in Col.3/ll.59-60.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to construct an EUV-projection exposure system according to Yamamoto (Ch), thereby adding a mask, an objective lens, and a light-sensitive object (e.g., a semiconductor wafer) to the system, as taught by Tanitsu, since the additional elements are vital parts needed in a photolithography system which is currently in high demand in the semiconductor industry, as indicated by Tanitsu in Col.1/ll.13-47.

One would have been motivated to modify Yamamoto (Ch)'s into an EUV photolithography system by replacing all conventional components by EUV-compatible parts, since EUV lithography is needed to produce the tiny patterns in the state-of-the-art semiconductor chips.

- Regarding claim 59, the step of using Yamamoto (Ch)'s system as modified by Tanitsu (claim 58) for the production of microelectronic components is indicated by Tanitsu in Col.1/ll.14-15.


It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the EUV-projection exposure system of claim 58 as a photolithography system for the production of microelectronic components, which has been previously indicated by Tanitsu in Col.1/ll.13-47.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Bernard E Souw whose telephone number is 703 305 0149. The examiner can normally be reached on Monday thru Friday, 9:00 am to 5:00 pm..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John R Lee can be reached on 703 308 4116. The fax phone numbers for the organization where this application or proceeding is assigned are 703 872 9318 for regular communications and 703 872 9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308 0956.

bes
June 17, 2002


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